II. 5. PERFORMANCE SPECIFICATIONS

The performance specifications of the Welch Allyn Vital Signs Monitor are as follows:

CUFF PRESSURE RANGE
0 mmHg - 300mmHg

INITIAL CUFF INFLATION
Default cuff inflation pressure is 160 mmHg. Operator may change this default in configuration mode. Options are 120, 140, 160, 180, 200, 240 and 280 mmHg.

SYSTOLIC DETERMINATION
Maximum: 250 mmHg
Minimum: 60 mmHg

DIASTOLIC DETERMINATION
Maximum: 160 mmHg
Minimum: 30 mmHg

BLOOD PRESSURE ACCURACY
Blood pressure accuracy meets or exceeds SP10-1992 AAMI standards for non-invasive blood pressure accuracy (AAMI standard: ± 5 mmHg mean error; 8 mmHg standard deviation). Blood pressure accuracy is validated for pressure measurement using the upper arm only, with the patient in a seated position. Blood pressure is validated against manual auscultatory readings.

BLOOD PRESSURE DETERMINATION TIME
20 seconds to 45 seconds typical, 165 seconds maximum.

PULSE RATE DETERMINATION
Maximum: 200 bpm
Minimum: 40 bpm

PULSE RATE ACCURACY

SpO_2 Module Heart Rate (Nonin®)	±3.0%
SpO_2 Module Heart Rate (Nellcor Puritan Bennett™)	±3 bpm
Blood Pressure Algorithm Heart Rate	±5.0%

OVERPRESSURE CUTOFF
295 mmHg to 330 mmHg

TEMPERATURE DETERMINATION

Normal and Monitor Modes:	Maximum	108.0°F (42.2°C)
	Minimum	84.0°F (28.9°C)

TEMPERATURE ACCURACY
Temperature accuracy meets ASTM E112-86: "Standard Specification for Electronic Thermometer for Intermittent Determination of Patient Temperature."

TEMPERATURE DETERMINATION TIME (ORAL)
Normal Mode: ORAL: 4 seconds typical, 15 seconds maximum
Monitor Mode: ORAL: 3 minutes

OXYGEN SATURATION RANGE (SpO_2%)
40-99% oxygen saturation

SpO_2 ACCURACY
Nonin® Pulse Oximeter Module
Saturation (%SpO_2 ± 1 Standard Deviation*)
70-99% ± 2 digits
< 70% unspecified

Nellcor Puritan Bennett™ Pulse Oximeter Module
Saturation (%SpO_2 ± 1 Standard Deviation*)
70-99% ± 3 digits
< 70% unspecified

* Standard Deviation is a statistical measure: up to 32% of the readings may fall outside these limits.

BATTERY CHARGING
To at least 90% capacity in 12 hours. Unit will operate and charge battery simultaneously when connected to power source.

A fully charged battery will support 200 "typical" blood pressure determinations taken at 3 minute intervals. Battery is 90-100% charged after 12 hours of charging. The battery automatically charges when the monitor is powered through the AC power transformer. The battery will charge faster when the instrument is not in operation.

II. 6. A. TECHNICAL SPECIFICATIONS: MECHANICAL SPECIFICATIONS

DIMENSIONS

Height	6.5 inches	(16.5cm)
Length	8.6 inches	(21.8cm)
Depth	5.0 inches	(12.7cm)

WEIGHT
Approximately 6 pounds (2.8Kg)

COLOR
Oral / Axillary Temperature Probe - Blue
Rectal Temperature Probe - Red

MOUNTING

Self-Supporting on rubber feet
IV Pole Mountable
Custom Mobile Stand
Wall Mountable
Attaches to Bed Rail

PORTABILITY

- May be hand carried when held by the recessed handle.
- When attached to an IV pole, or mounted on its custom mobile stand, the monitor and accessories can be wheeled from patient to patient.
- When attached to the bed rail may be transported with the patient within the hospital environment.

OPERATOR INSTRUCTIONS/ALARM INTERPRETATION

Comprehensive Operator Manual available. Quick reference operator instruction card available.

II. 6. B. ELECTRICAL SPECIFICATIONS

POWER REQUIREMENTS

Patient-Rated isolation transformer is connected to AC mains power source:

North American Version: 120VAC, 60 Hz., 0.20A Input Source; 8Vdc, 0.75A Output Source
International Versions: 230VAC or 240VAC, 50Hz., 0.20A Input Source; 8Vdc, 0.75A Output Source

BATTERY

Lead acid, with external recharge capability.

II. 6. C. ENVIRONMENTAL SPECIFICATIONS

OPERATING TEMPERATURE

+10°C to +40°C
+50°F to +104°F
Exception: Thermometry module will not maintain its performance characteristics below 60°F (16°C).

OPERATING ALTITUDE

-170m to +4877m
-557ft. to +16,000ft.

II. 6. D. TRANSPORTATION/STORAGE CONDITIONS

STORAGE TEMPERATURE

-20°C to +50°C
-4°F to +122°F

RELATIVE HUMIDITY

15 to 90% (non-condensing)

SECTION V
TROUBLESHOOTING/ MAINTENANCE/CALIBRATION

1. Troubleshooting: Error Indications and Interpretation
2. Troubleshooting: General Guide to Problems and Corrective Actions
3. Maintenance
    a. Cleaning
    b. Storage
    c. Battery Removal and Replacement
4. Calibration
    a. Blood Pressure Calibration Check
    b. Temperature Calibration Check
    c. SpO_2 Calibration Check

V. 1. TROUBLESHOOTING: ERROR INDICATIONS AND INTERPRETATION

The following table of alarm conditions and error codes is intended to provide the operator with a quick reference to the descriptions and probable causes of the error codes. For service level troubleshooting, refer to the service manual.

When responding to a Monitor alarm, always CHECK THE PATIENT FIRST and then proceed to check the Monitor.

Press CANCEL to reset patient alarm conditions.

ERROR CODE	MEASUREMENT MODE	DESCRIPTION	CORRECTIVE ACTION
C01	Blood Pressure	Measurement cycle was cancelled by operator	-------
C02	Blood Pressure	Autozero Failure	Check for air obstruction, limit patient movement
C03	Blood Pressure	Inflation too rapid	Check for kinked hose or air obstruction
C04	Blood Pressure	Excessive inflation time	Check for air leaks
C05	Blood Pressure	Excessive noise	Check patient condition, cuff placement, limit patient movement
C06	Blood Pressure	Measurement was outside of Monitor's measurement range	Check patient condition
E10	Blood Pressure	Cuff overpressure condition	Check patient condition
C20	Temperature	Broken / missing probe	Replace probe
C21	Temperature	Probe not ready	Replace probe in holder, wait 15 seconds, retry
E0.0 thru E9.9	Temperature	Internal malfunction	Contact customer service
"P"	Temperature	Loss of tissue contact	Insure proper probe positioning

ERROR CODE	MEASUREMENT MODE	DESCRIPTION	CORRECTIVE ACTION
"--"	SpO_2	Sensor Error	Check patient condition, sensor position and connection
E7	SpO_2	Internal Malfunction	Contact customer service.
E11	General	Internal safety violation	Check patient, contact customer service
E12	General	Ambient temperature out of range	Adjust temperature or monitor location
E13	General	Battery failure	Use wall transformer
E20 thru E50	General	Internal malfunction	Contact customer service

V.2. TROUBLESHOOTING: GENERAL GUIDE TO PROBLEMS AND CORRECTIVE ACTIONS

Symptom	Possible Cause	Explanations and Corrective Action
1 INACCURATE BLOOD PRESSURE READINGS **Please note:** *Differences of up to 10mmHg should be considered normal and will occur for a number of reasons including intrapatient BP variability, observer hearing differences, and auscultatory deflation rate.*	**Incorrect cuff size** Note: Use Welch Allyn approved cuffs only.	**Determine correct cuff size:** • Use reference markings on cuff • Measure patient's arm circumference midway between elbow and shoulder (see page 42 of Operator's Manual to select correct cuff size).
	Patient's arm position	**Ensure patient's arm is at heart level.**
	Arm movement during blood pressure cycle	**Keep arm still during blood pressure cycle:** • Movement may cause inaccuracies from artifact.
	Blood pressure taken over clothing	**Blood pressure should be taken on a bare arm.**
	Arrhythmia	**Check for regularity of heart rate:** *(palpate pulse or check monitor)* • Moderate to severe heart rate irregularities may make blood pressure difficult to measure.
	Incorrect reference	**Use the correct Korotkoff sound to determine diastolic blood pressure.** • Many listeners incorrectly equate diastolic blood pressure with the disappearance of sound only (phase 5). The Welch Allyn Vital Signs Monitor was developed using the American Heart Association recommendations, which state that phase 5 be used unless sound continues to 0 mmHg, in which case the change in the quality of sound (phase 4) is to be used. **Deflate cuff no faster than 3 mmHg per second:** • One of the major sources of error in auscultatory blood pressure measurement is deflating the cuff too quickly. The American Heart Association recommends deflation no faster than 3 mmHg per second. **Only use a sphygmomanometer that is known to be in calibration:** • Blood pressure taken with an un-calibrated sphygmomanometer may be very inaccurate.
	Change in blood pressure from auscultatory reading to Welch Allyn Vital Signs Monitor reading	**Check blood pressure immediately prior to Welch Allyn Vital Signs Monitor Reading.**
	Poor auscultatory sound recognition by observer	**Use higher quality stethoscope. Have a different observer check patient's blood pressure.**

Symptom	Possible Cause	Explanations and Corrective Action
2 CUFF INFLATION & DEFLATION WITH NO BLOOD PRESSURE READING DISPLAYED (or error code in display)	**Leak in pneumatic system**	**Ensure all cuff attachments are tight.** **Carefully check for tubing leaks in blood pressure cuff and tubing attachment to monitor.**
	Arm movement during cycle	**Keep arm still during blood pressure cycle:** • movement may cause inaccuracies from artifact
	Tubing movement artifact	**Do not contact tubing during blood pressure cycle:** • movement may cause inaccuracies from artifact
3 NO CUFF INFLATION	**Connections from monitor to cuff loose**	**Check all connections.** (Do not over tighten).
4 TEMPERATURE MALFUNCTION	**Broken probe**	**Replace probe.** **Consult Technical Manual.** **Notify Biomedical department or Welch Allyn Technical Support.** **Wait for display window to read OrL before placing probe.**
	Improper probe placement	**Place probe in most posterior sublingual pocket.** **Notify Biomedical department or Welch Allyn Technical Support.**
	Probe not replaced	**Replace probe in holder prior to taking another temperature.**
5 SpO_2 MALFUNCTION • **Sensor in Place but No $Sp0_2$ on Display**	**Improperly attached sensor**	**Insert the patient's finger completely into sensor**
	Cable incorrectly plugged into monitor	**Ensure sensor cable is correctly plugged into monitor**
	$Sp0_2$ disabled	**Ensure $Sp0_2$ is enabled (check Configuration Mode)**
	Incorrect Sensor	**Ensure that correct manufacturers sensor is in use** • Nonin® and Nellcor Puritan Bennett™ sensors are <u>not</u> interchangeable
• **Inaccurate $Sp0_2$ Reading**		
6 PRINTER MALFUNCTION	**Paper will not advance**	**Consult Technical Manual** **Notify Biomedical department or Welch Allyn Technical Support.**
7 MONITOR WILL NOT TURN ON	**Low battery**	**Check connections between monitor and transformer, and transformer and wall receptacle.**
	Monitor not powering up	**Unplug unit from wall receptacle and check for breaks in cord. If connections secure, check electrical outlet** • Charging light will be on if connections are OK and the monitor is plugged into a working outlet **Notify Biomedical Department or Welch Allyn Technical Support.**
8 CUFF TOO TIGHT (Over inflation)	**Pressure Preset too high**	**Check default Pressure Preset setting: (in Configuration Mode)** • Unless patient has underlying systolic hypertension, set pressure preset at 160 mmHg. (If systolic blood pressure greater than pressure preset, monitor will automatically increase an additional 40 mmHg)
9 CUFF POPPING OFF	**Inappropriate size cuff**	**Determine cuff size with the cuff markings or refer to chart in Operator's Manual for determining cuff size.** • If cuff continues to pop off, notify Biomedical Department or Welch Allyn Technical Support.
	Cuff applied inside out	**Re- apply cuff:** • Make sure Welch Allyn label is facing away from arm.

Symptom	Possible Cause	Explanations and Corrective Action
10 CUFF DEFLATING TOO SLOWLY	**Normal operation**	**Typical time to take a reading is 20 to 45 seconds. 165 seconds is the maximum.**
	Pressure Preset too high	**Check default Pressure Preset setting. (in Configuration Mode)**
	Patient movement	**Have patient sit still.** Do not have arm tight against chest wall as respirations may affect speed and accuracy of blood pressure measurement.
	Small leak in pneumatic system	**Check cuff and tubing for leaks.**

QUICK GUIDE TO TAKING A MANUAL (AUSCULTATORY) BLOOD PRESSURE

Action	EXPLANATION
1 Collect appropriate equipment. Use a certified accurate sphygmomanometer and quality stethoscope. Select a blood pressure cuff of a suitable size. Use a blood pressure cuff of the largest appropriate size for patient (see markings on inside of cuff).	Many sphygmomanometers are inaccurate. Low quality stethoscopes do not transmit sound well enough for blood pressure sounds to be heard accurately. A cuff that is either too large or too small will produce an inaccurate reading.
2. Have the patient assume a comfortable position with the upper arm relaxed at heart level and the lower arm passively supported.	If the arm is not at the proper level, inaccurate readings will result.
3. Expose the area of the brachial artery by removing clothing, or move a sleeve, if not too tight, above the area where the cuff will be placed.	Clothing over the artery hinders the ability to hear and may cause inaccurate readings. Tight clothing may cause vessel congestion and inaccurate readings.
4. Center the cuff bladder so that the lower edge is at least 1 inch (2.5cm) above the bend of inner arm of the elbow.	This places the cuff in the best position for occluding the blood flow through the brachial artery.
5. Palpate the brachial or radial pulse.	Determines the most accurate location for assessment and approximation of systolic pressure.
6. Inflate the cuff until the pulsation disappears. Then continue to inflate until the pressure reads 30 mmHg above the point where the pulse disappeared.	Facilitates identification of Phase One of Korotkoff sounds.
7. Listen carefully with stethoscope over brachial artery while controlling the release of air at a rate of 3 mmHg per second.	One of the major sources of error in auscultatory blood pressure measurement is deflating the cuff too quickly. It is a normal operation of the Welch Allyn Vital Signs Monitor to deflate at the American Heart Association recommended 3 mmHg per second.
8. Systolic is determined by reading the manometer gauge when the first faint but clear tapping sound is heard with the stethoscope.	Follows AHA recommended standards.
9. Diastole, in adults, is determined by reading the manometer gauge to the closest even number when the last sound is heard.	Follows AHA recommended standards. Diastolic blood pressure in children is the point at which the sound becomes muffled.
10. Release the air quickly after at least 10 to 20 mmHg of silence.	

2.3 Replacement Parts – Welch Allyn

In addition to individual parts listed below, SPARE PARTS KITS have been made up for your convenience. This assures that you will have all the mounting materials and other small items needed for a repair. The foam pads mounted on the battery are one such example. Kits will not be broken down. FOR AUTHORIZED REPAIR SITES ONLY.

Welch Allyn Replacement Parts:

PART#:	DESCRIPTION:
130S46-E	English Front Housing Kit
130S46-S	Spanish Front Housing Kit
130S46-F	French Front Housing Kit
130S46-G	German Front Housing Kit
130S46-I	Italian Front Housing Kit

Includes: front housing with loose labels. Four different types of labels for the four different configurations i.e.:
BP w/Printer Only,
BP w/Printer + Temp,
BP w/Printer + SpO_2,
BP w/Printer + Temp + SpO_2

130S51	Front Housing Switch Array
130S45*	Main PCB Assembly Includes: hardware
130S4*	Display PCB Assembly Includes: hardware
130S5*	Valve
130S6	Pneumatic Connector Includes: connector, washer, nut, and grommet
130S39*	Pump Assembly Includes: pump, cable tie mount, 2 cable ties, foam pads, instructions, specifications
130S40E	English Rear Housing Kit
130S40F	French Rear Housing Kit
130S40G	German Rear Housing Kit
130S40I	Italian Rear Housing Kit
130S40S	Spanish Rear Housing Kit
130S9	Power Jack
130S10	Back Panel Includes: panel and hardware
130S41	Tubing Assembly Includes: all tubing, “T” fitting, instructions
130S13	Bumpers (2 ea.)
130S14	Battery Access Plate Includes: plate and hardware
130S47	Wire Harness Includes: 14 pin MTA connector, 3 pin MTA connector, faston receptacles for the power supply, power jack, battery, and valve lead wires all assembled
130S16	Temperature Plug
130S17	Printer Assembly Includes: thermal printer, double faced adhesive foam all assembled
130S18*	Printer Housing Includes: housing, switch array, PCB, hardware, flex strip
130S48	RS232 Cable Includes: DB9 connector, hardware, 4 pin MTA, lead wires all assembled

PART#:	DESCRIPTION:
130S42*	SpO_2 PCB (Nonin) Includes: PCB with cable attached, DB9 connector and cable (not attached), and hardware with instructions
130S49	SpO_2 Sensor Interconnect (Nonin) Includes: lead wires and 4 pin MTA connector
130S52*	Temperature PCB Assembly Includes: PCB, hardware, lead wire and connectors
130S53	Temperature Connector Includes: connector, lead wires and hardware
130S24	Temperature Probe Housing Includes: housing and hardware
130S27	Printer Paper Cover
130S28	Cable, DB9 Female to DB9 Female 42" long
130S29E	Software, Repair
130S43	Kit, Repair, Nellcor SpO_2 PCB with connector
130S50	Kit, Repair, SpO_2 Cable (Nellcor)
130S54	Kit, Repair, SpO_2 Cable to Main (Nellcor)
130S37	Upgrade, Software, Version 3.11
41P100**	Check Valve
117S144**	DC to DC Converter
114S588**	Pressure Sensor
66S530**	“Printer, Flat Cable”
5200-01	Cuff Assy, Adult with 1 tube bag
5200-02	Cuff Assy, Lg Adult with 1 tube bag
5200-03	Cuff Assy, Child Print with 1 tube bag
5200-04	Bag, Adult with cut tube
5200-05	Bag, Lg Adult with cut tube
5200-06	Bag, Child with cut tube
5082-59	Cuff, Adult Black
5082-61	Cuff, Lg Adult Black
5082-63	Cuff, Child Print
5200-07	Pressure Hose with new Luer fitting
5200-08	Calibration T connector
5200-20	Probe, Oral 9 Ft, Diatek
5200-22	Probe, Rectal 9 Ft, Diatek
5200-40	Sensor, $SSpO_2$ Finger Clip (3 meter cord) (Nonin)
5200-41	Sensor, SpO_2 Ear Clip (Nonin)
5200-42	Sensor, SpO_2 Flex (Nonin)
5200-44	Sensor, $SSpO_2$ Reflectance (Nonin)
5200-45	Holder, SpO_2 Reflectance Sensor (Nonin)
5200-46	Sensor, SpO_2 Adult Finger Flexi-form (Nonin)
5200-47	Sensor, SpO_2 Ped Finger Flexi-form (Nonin)
5200-50	Tape, SpO_2 Sensor Attachment (Nonin)
5200-51	Tape Strips, Hydrogel for SpO_2 (Nonin)
5200-52	Cable, SpO_2 Extension 3 Ft (Nonin)
5200-53	Kit, SpO_2 Finger Phantom Calibration (Nonin)
5200-54	Sensor, SpO_2 Finger Clip (1 meter cord) (Nonin)
5200-12	Tubing, straight 8 ft. with fitting
5200-56	Pediatric Finger Clip Sensor (Nonin) 9 ft. cable
5200-55	Extension Cord 10 ft. for SpO_2 sensor (Nonin)

PART#:	DESCRIPTION:
5200-60	Mobile Stand Kit
5200-61	Mobile Stand Kit, Modified
5200-62	Wall Mount Kit
5200-63	Wall Mount Kit, Modified
5200-64	IV Pole Kit
5200-65	IV Pole Kit, Modified
5200-66	Bed Rail Kit
5200-67	Bed Rail Kit, Modified
5200-68	Cuff Clip
5200-69	Accessory Pack
7052-25	Printer Paper (5 rolls)
5200-101	Transformer, USA 120V, 60 Hz
5200-102	Transformer, Europe 220V, 50 Hz
5200-103	Transformer, UK 230V, 50 Hz
5200-103	Transformer, Australia 230V, 50 Hz
5200-110	Power Cord, USA/Japan
5200-111	Power Cord, Europe
5200-112	Power Cord, UK
5200-113	Power Cord, Australia
5200-114	Power Cord, Switzerland
5200-115	Power Cord, South America
5200-84	Battery, 6 Volt Lead Acid
D-25	OXISENSOR II adult digit oxygen transducer (Nellcor)
D-25L	OXISENSOR II adult digit oxygen transducer with long cable (Nellcor)
D-20	OXISENSOR II pediatric oxygen transducer (Nellcor)
R-15	OXISENSOR adult nasal oxygen transducer (Nellcor)
I-20	OXISENSOR II infant digit oxygen transducer (Nellcor)
EC-8	Extension Cable – 8 foot (Nellcor)
OXICLIQ-A	Adult oxygen transducer for use only with OXICLIQ sensor cable OC-3 (Nellcor)
OXICLIQ-P	Pediatric oxygen transducer for use only with OXICLIQ SENSOR CABLE MODEL OC-3 (Nellcor)
OXI-A/N	OXIBAND adult/neonatal oxygen transducer (Nellcor)
OXI-P/I	OXIBAND pediatric/infant oxygen transducer (Nellcor)
RS-10	Reflectance oxygen transducer (Nellcor)
D-YS	DURA-Y oxygen transducer (Nellcor)
SRC-2	Portable oximetry tester (Nellcor)
DS100A	DURASENSOR adult oxygen transducer (Nellcor)
OC-3	Cable, OXICLIQ Sensors (Nellcor)
D-YSE	Ear Clip (use with DURA-Y sensor) (Nellcor)
D-YSPD	Pedicheck Pediatric Spot-Check (use with DURA-Y Sensor) (Nellcor)
ASP-3	Sensor Assortment Pack (Nellcor)
05031-101	Diatek Probe Covers
5200-25	Temperature Cal. Key
01800-210	Model 9600 Temperature Cal. Kit 110V.
5200-85E	Operations Manual
5200-145E	Service Manual

* - Indicates that these parts can be traded in. If the part is under warranty, with a trade in you get full credit. If the parts is out of warranty, you will get a 40% discount from the price."

** - Only regional service centers may purchase these parts.

See section 1.1 for ordering parts.

2.4 Welch Allyn Vital Signs Monitor Maintenance and Service Support

Owner Maintenance: Non-Technical customers can perform normal maintenance per the instructions provided in the Operator Manual, Section **V**. End users will be able to perform basic operations such as replacement of: hoses, cuffs, probes, printer paper and batteries. On this level the unit will not be opened. However, opening of the WELCH ALLYN VITAL SIGNS MONITOR by untrained individuals may damage the unit and void the warranty.

Technical Service/Repair/Re-calibration: Properly trained and equipped bio-medical departments and service centers will be able to utilize the content of this Service Manual. Technical skills in electronics and PC skills are required. These departments and centers must have service manual and re-calibration software, repair tools and test equipment as listed in this manual. They must also have minimum recommended quantities of repair parts and sub-assemblies. See the listings of repair parts and kits in this manual.

3.7 TROUBLE SHOOTING GUIDE

Symptom	Possible Cause	Explanations and Corrective Action
1. Inaccurate Blood Pressure Readings Please note: Differences '10mmhg should be considered 'normal and will occur for a number of reasons including intrapatient BP variability, observer hearing differences, and auscultatory deflation rate.	**Incorrect Cuff Size**	**Determine correct cuff size:** • use reference markings on cuff • measure patient's arm circumference midway between elbow and shoulder (see page 42 of Operator's Manual to select correct cuff size).
	Patient's Arm Position	**Ensure Patient's arm is at heart level.**
	Arm Movement During blood pressure cycle	**Keep arm still during blood pressure cycle:** • movement may cause inaccuracies from artifact
	Blood Pressure taken over clothing	**Blood Pressure should be taken on a bare arm.**
	Arrhythmia	**Check for regularity of heart rate: (palpate pulse or check monitor)** • moderate to severe heart rate irregularities may make blood pressure difficult to measure.
	Incorrect Reference	**Use 4th Korotkoff sound to determine diastolic blood pressure.** • Many listener's incorrectly equate diastolic blood pressure with the disappearance of sound. The Vital Signs Monitor was developed using the 4th sound, as recommended by the American Heart Association.
	Change in blood pressure from auscultatory reading to Vital Signs Monitor reading	**Deflate cuff no faster than 3mmhg per second:** • One of the major sources of error in auscultatory blood pressure measurement is deflating the cuff to quickly. The American Heart Association recommends deflation no faster than 3mmhg per second. **Only use a spygnomometer that is known to be in calibration:** • Blood pressure taken with un-calibrated sphygmomanometer may be very inaccurate. **Check blood pressure immediately prior to Vital Signs Monitor Reading**
	Poor auscultatory sound recognition by observer	**Use higher quality stethoscope** **Have a different observer check patient's blood pressure**

3.7 TROUBLE SHOOTING GUIDE

Symptom	Possible Cause	Explanations and Corrective Action
2. Cuff Inflation & Deflation With No Blood Pressure Reading Displayed. **(or error code in display)**	**Leak in pneumatic system**	**Make sure all cuff attachments are tight.** **Carefully check for tubing leaks on blood pressure cuff and tubing attachment to monitor.**
	Arm Movement During Cycle	**Keep arm still during blood pressure cycle:** • movement may cause inaccuracies from artifact.
	Tubing Movement Artifact	**Do not contact tubing during blood pressure cycle** • movement may cause inaccuracies from artifact.
3. No Cuff Inflation	**Connections from monitor to cuff loose**	**Check all connections. (Do not over tighten).**
4. Temperature Malfunction • Error code displayed	**Broken Probe**	**Replace Probe** **Consult Technical Manual** **Notify Biomedical department or Welch Allyn Customer Service (800) 854-2904**
• Low Temperature Readings	**Improper Probe Placement**	**Wait for display window to read ORL before placing probe** **Place probe in most posterior sublingual pocket**
• No Temperature Displayed	**Probe not Replaced**	**Notify biomedical or Welch Allyn Customer Service.** **Replace probe in holder prior to taking another temperature.**
5. SPO2 Malfunction • Sensor in place but no SPO2 on display	**Improperly attached sensor**	**insert the patient's finger completely into sensor**
	Cable incorrectly plugged into monitor	**Be sure sensor cable is correctly plugged into monitor**
	SPO2 disabled	**Be sure SPO2 is enabled with Mode button -** (SPO2 light will be off when disabled)
• Inaccurate SPO2 Reading	**Incorrect Sensor**	**Assure that correct manufacturers sensor is in use -** they are not interchangeable

3.7 TROUBLE SHOOTING GUIDE

Symptom	Possible Cause	Explanations and Corrective Action
6. Printer Malfunction	**Paper will not advance**	**Consult Technical Manual** **Notify Biomedical or Welch Allyn Customer Service.**
7. Monitor Will Not Power Up	**Low Battery**	**Check connections between monitor and transformer and wall receptacle.**
	Monitor not plugged in	**Unplug unit from wall receptacle and check for breaks in cord. If connections secure and power supply is intact.** **Notify Biomedical Department or Welch Allyn Customer Service.**
8. Cuff Too Tight (over inflation)	**Pressure Preset too high**	**Check pressure preset setting:** • Unless patient has underlying systolic hypertension, set pressure preset at 160mmhg. (If Systolic blood pressure is greater than 'pressure preset, monitor will automatically 'increase an additional 40mmhg).
9. Cuff Popping Off	**Inappropriate size cuff**	**Determine cuff size with the cuff markings or refer to chart in Operator's Manual for determining cuff size.** • If cuff continues to pop off, notify Biomedical Department or Welch Allyn Customer Service.
	Cuff applied inside out	**Re apply cuff:** • make sure smooth surface of velcro is facing patients arm
10. Cuff Deflating Too Slowly	**Normal Operation**	**Deflate cuff no faster than 3mmhg per second:** • One of the major sources of error in auscultatory blood pressure measurement is deflating the cuff too quickly. The American Heart Association recommends deflation no faster than 3mmhg per second.
	Pressure Preset too high	**Check pressure preset setting**

5.1 Calibration Test

ABSTRACT: The following is the test procedures for the WELCH ALLYN VITAL SIGNS MONITOR. We set this procedure up so that you can start at section 5.1 and go straight through the procedure or you can skip around. However, you must do all of the test called out in this section before a unit can be returned to field service.

NOTES:
A. The word “unit” in this text refers to the WELCH ALLYN VITAL SIGNS MONITOR.
B. ***Menu|Choice*** represents menu commands. Rather than use the phrase “choose the Exit command from the File menu.”

1. **Connect** the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station (see Section 2, Figure 2.2.1). Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service
   port connector to the computer. Start the computer program by double clicking on its program icon.

2. **Remove** the battery and hook unit up to the power supply and the digital voltage meter. Power supply should be set at 6.5Vdc.

3. **Turn on the unit** and in the program choose ***Unit|Information.*** Confirm that the information displayed on the screen matches that of the unit under test. Note : If the software returns an ERROR message, check the communications link, and re-send the command. If the communications return another error close the information dialog box then select ***Tools|Options*** and check that the correct communications port is selected. Place the unit into the “Detailed Test” mode by holding down the “start” and “cancel” buttons as power is applied.

4. **Observe** the unit. **Verify** that the software versions displayed on the LED displays meet the specifications called out in the Repair Test Specifications document.

5. **Press** the review button on the unit. The systolic window should read “CAL.”

6. **Attach** a pneumatic clamp to the 100cc and the 250cc volume, remove the clamp from the 500cc volume.

7. ***Choose Test|Calibration.*** The dialog box will display the units primary and safety transducer manometer readings, unit battery reading, valve and pump status.

Note : Use Start button to close valve, and hand bulb to set the pressures.

8. **Verify** that the unit is within calibration specification at all the following target pressures: 0, 50, 150, and 250 mmHg. All target pressures have a tolerance of +/- 5 mmHg. Specification are found in the Repair Test Specifications document.

9. **Press** the “review” button until the systolic window reads “bat.”

10. **Set** the power supply to 5.7 +.05,-0 Vdc (5.7 to 6.0 Vdc). Verify that the voltage reading of the unit meets specification called out in the Repair Test Specification document. Return the power supply to 6.0 ±0.25 Vdc upon completion of this test.

11 **Press** Close to exit from the “Test Calibration” dialog box.

5.2 Current Tests

1. **Connect** the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Turn unit off unit then re-power unit allowing the unit to boot up into its normal mode.

3. Click on ***Test|Current Levels.*** Check the following current levels:
   a. Blank
   b. Idle
   c. Pump
   d. SpO_2
   e. Temperature

4. Verify these currents meet the specifications called out in the Repair Test Specification document.

5. Press Close button to exit dialog box.

5.3 Noise Levels

1. Connect the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Click on ***Test/Noise Levels.***

3. Press Test button to retrieve the units internal pressure channel noise level. Verify that the noise level meets the specification called out in the Repair Test Specification document.

5.4 Button Test

1. Connect the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Choose ***Test|Button Test.*** Press each button and ensure that the computer acknowledges it, via the "Button Pressed" display. Each button should also cause the units display to change to one of the settings noted below.

KEY	RESPONSE
Power	0
Start	1
Cancel	2
Review	3
Auto	4
Silence	5
Down	6
Up	7
Select Alarm	8
Volume	9
Feed	F
Print	P
Invalid response	E

F,P - When printer option is installed
E - Usually multiple keys pressed.

3. Press Close button to exit from dialog box.

5.5 Print Quality

1. Connect the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Choose ***Test/Print Quality.*** Choose “test pattern 1.” The printer will print out a pattern of large and small ASCII characters. Verify the quality of the printer output. Once test 1 is complete, choose “test pattern 2.” The printer will print out a solid gray field. Verify the quality of the printer output.

Note : This option will only work when the printer option is installed.

5.6 Pneumatics Tests

1. Connect the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Place unit into the “detailed test” mode. Do this by holding down the start and cancel buttons as the unit is powered up. Clamp off the 500cc and 250cc volumes, leaving the 100cc volume connected to the unit. Press the “review button” until “CAL” appears. Press the Start button to close the units valve. Using the hand bulb inflate the unit to the first test pressure, 250mmHg +/- 5mmHg (245 to 255 mmHg), and wait 15 seconds to stabilize.

3. Select ***Test|Pneumatic,*** and then the “Leak Test” option. Press the Test button to perform the first leak test. The test lasts 15 seconds. Once the test is complete the pressure change is displayed in the “Pressure” box. Verify that the leak rate meets the specification called out in the Repair Test Specification document.

   Press the Cancel button to open the unit valve and release the pressure.

   Note : The software will verify that the pressure is 250mmHg +/- 5mmHg, before it will begin a leak test.

4. Open the valve on the bulb and release pressure to the second test pressure, 50mmHg +/- 5mmHg (45 to 55 mmHg), and wait 15 seconds to stabilize.

   Press the Test button to perform the second leak test. The test lasts 15 seconds. Once the test is complete the pressure change is displayed in the “Pressure” box. Verify that the leak rate meets the specification called out in the Repair Test Specification document.

5. Press the Cancel button to open the unit valve and release the pressure.

   Note : The software will verify that the pressure is 50mmHg +/- 5mmHg, before it will begin a leak test.

6. Power down the unit and power the unit back up allowing it to boot up into its normal mode.

7. Remove the clamp from the 250cc volume and place it on the 100cc volume. Select the “Inflation Test” option, and press the Test button. The unit will perform an inflation test. The inflation time is displayed in the “Timer” box. Verify that the inflation time meets the specification called out in the Repair Test Specification document.

8. Remove the clamp from the 500cc volume and place it on the 250cc volume. Select the “Dump Test” option, and press the Test button. The unit will perform a dump test. The dump time is displayed in the “Timer” box. Verify that the dump time meets the specification called out in the Repair Test Specification document.

9. Disconnect the test equipment pneumatic hose from the unit. Connect the large cuff with coiled tubing to the unit’s manifold. Wrap the large cuff around the 500cc volume, insuring that the white line, that runs along the end of the cuff, lines up with the “N” in the word “RANGE.” Select the Deflation Test option, and press the “TEST” button. The unit will do a normal blood pressure cycle and then display the step pressures in the “Valve Step Array Data” box. Verify that the step array data meets the specifications called out in the Repair Test Specification document.

   Click on Close when all tests have been completed.

5.7 Hardware Fail-safe

1. Connect the WELCH ALLYN MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Place the unit into the “Detailed Test” mode. Do this by holding the “start” and “cancel” button as the unit is powered up. Press the review button until “CAL” appears in the systolic window.

3. Select the ***Test|Hardware Fail-safe*** menu item.

4. Select the “Over Pressure” test, remove the cuff from the unit and attach the test station’s Pneumatic tubing to the unit. Press the Test button. Using the hand bulb, slowly increase the pressure, while observing the external pressure meter. The unit will return the hardware failsafe condition, E10. At this point, record the highest pressure observed on the external pressure meter. Verify that the over pressure value meets the specification called out in the Repair Test Specification document.

5. Press the Review button until ‘LFE’ appears in the systolic window.

6. Press the ‘start’ button and allow the VSM unit to test the over 15mmHg fail safe (test 1) and the repeat cycle test (test 2).

7. If no errors appear in the systolic window during the duration of the tests, and the unit goes into the “normal” life cycle tests, then the 15mmHg/repeat cycle tests are successful.

8. Press the cancel button to stop the ‘life test.’ Press review until the software version is seen on the display. Turn unit ‘off’ then back ‘on’ into the normal mode.

5.8 SpO_2 Tests

5.8.1 Nonin SpO_2

1. Connect the Nonin SpO_2 simulator to the unit with the test cable. The reading of the SpO_2 should be within the specified range indicated on the simulator.

2. Reconnect the SpO_2 sensor. Place the sensor onto your finger. The unit should return a reading if the sensor is OK.

5.8.2 Nellcor SpO_2

1. Connect the Nellcor SpO_2 simulator to the unit with the test cable. Make sure that the following settings* of the simulator are selected:

   Rate: 112
   Light: High 1
   Modulation: High
   RCAL Mode: RCAL63/Local

   Insure that the readings of the SpO_2 are within the specifications indicated on the simulator.

2. Reconnect the SpO_2 sensor. Place sensor onto your finger. The unit should return a reading if the sensor is OK.

*Note: On the Nellcor Simulator, if the settings are outside what is called out above, the alarms will activate on the monitor.

5.9 Temperature Tests

1. Disconnect the temperature probe from the unit leaving the probe itself in its housing. Place the “CAL key” into the connector. Remove the probe from the housing. The temperature should read the same as what is specified on the "cal" key. Remove the “cal” key and reconnect the probe. Place probe back into the housing.

2. Make sure that the unit’s temperature option is in the “monitor mode”. Do this by removing the probe from the housing and observing the temperature display. “Monitor mode” should be seen in the lower right hand side of the display. If this is not seen, wait approximately 60 seconds and the unit will change mode to the “monitor mode.”

3. Set up the Diatek 9600 calibrator. Set the calibrator to 96.4 F (35.8 C) or use a water bath between 84 F (28.8 C) and 106 F (41.1 C). Allow the calibrator to stabilize for three (3) minutes. Place the probe into the small hole in the calibrator. Observe the temperature display, The reading should be within the specified range, within 30 - 45 seconds.

4. Place the probe back into the housing. Set the calibrator to 106 F (41.1 C). Allow the calibrator to stabilize for three minutes. Remove the probe from the housing, the unit must be in the monitor mode, if not wait until the unit is in that mode. Place probe into the small hole at the top of the calibrator. The reading should be within the specified range, within 60 seconds. If using a water bath skip this part of the test.

5.10 Nurse Call Testing

1. Power the unit ‘on.’
2. Using a Ohm meter, place the probes onto pin 7 and pin 8 of the RS232 connector.
3. Ensure that the Ohm meter reads infinite resistance (open circuit).
4. Create an alarm condition E11 by pinching off the pneumatic tube approximately 1 inch from the pneumatic port and pressing the start button.
5. Observe the Ohm meter, the meter should read 0.0 Ohms (short circuit).
6. Press the cancel button to stop the alarm.
7. Observe the Ohm meter again. The meter should again read infinite resistance (open circuit).

VSM Failure Tracking Sheet

Failure

Basic Info:

Date/Time:	
Observed by:	
Catalog Number:	
S/N:	
Unit SW Ver.:	
Life Cycle Count:	
Repair # (cust. returns)	

Location

- ☐ ATE, Config
- ☐ ATE, Final
- ☐ ATE, Ship
  - ATE SW Rev:
  - ATE Test #:
- ☐ Burn-In
- ☐ Assembly
- ☐ Customer
- ☐ Sales/Marketing
- ☐ QA
- ☐ Other

Test Failed / Reason for Return

- ☐ Error Code:
- ☐ LEDs
- ☐ Buttons
- ☐ Alarm
- ☐ Won't Power Up/Down
- ☐ BP, Won't Calibrate
- ☐ BP, Readings Too High
- ☐ BP, Other Problem
- ☐ Temp Problem
- ☐ SpO2 Problem
- ☐ Printer Problem
- ☐ Other. . .

Description:

Repair

Basic Info:

Date/Time:	
Repaired by:	

	Y	N
Was the problem repeatable?	☐	☐
Was a component replaced?	☐	☐
Was there an assembly error?	☐	☐
Was a procedure not followed?	☐	☐
Was there a test equipment problem?	☐	☐
Was there a design problem?	☐	☐

Primarily, the Following Component (if any) Was Involved in the Failure:

- ☐ Main Board
- ☐ Display Board
- ☐ Sp02 Board
- ☐ Temp Board
- ☐ Temp Connector Board
- ☐ Printer Board
- ☐ Main Cable
- ☐ Serial Cable
- ☐ Sp02 to Main Cable
- ☐ Sp02 to Sensor Cable
- ☐ Display Cable
- ☐ Printer Cable
- ☐ Charger Cable
- ☐ Valve
- ☐ Pump
- ☐ Printer
- ☐ Buttons
- ☐ Check Valve
- ☐ Battery
- ☐ Pneumatic Assembly
- ☐ Speaker
- ☐ Temp Probe
- ☐ SpO2 Sensor
- ☐ Other Component
- ☐ Not Applicable
- ☐ Temp Cable
- ☐ Transformer
- ☐ Pressure Switch

Description:

fm2004X.doc VSM Repair Form
Issue date: 5/18/99

Test Information:		**Acceptable Ranges**
Unit software version	_____	(>5.0)
Temperature s/w ver. (If available)	_____	(>21)
SpO_2 software version (if available)		(Nonin:>7; Nellcor:>1.2.0.0)
Test pressure @ 0 mmHg	_____	(-0.3 to 0.3mmHg)
Primary pressure @ 0 mmHg	_____	(-0.75 to 0.75mmHg)
Safety pressure @ 0 mmHg	_____	(±1mmHg)
Test pressure @ 50 mmHg	_____	(45 to 55mmHg)
Primary pressure @ 50 mmHg	_____	(±1.5mmHg)
Safety pressure @ 50 mmHg	_____	(±1.5mmHg)
Test pressure @ 150 mmHg	_____	(145 to 155mmHg)
Primary pressure @ 150 mmHg	_____	(±1.5mmHg)
Safety pressure @ 150 mmHg	_____	(±4.5mmHg)
Test pressure @ 250 mmHg	_____	(245 to 255mmHg)
Primary pressure @ 250 mmHg	_____	(±1.5mmHg)
Safety pressure @ 250 mmHg	_____	(±7.5mmHg)
Testvoltage 5.5 Vdc	_____	(5.5 to 6.0 Vdc)
Unit voltage 5.5 Vdc	_____	(±0.05Vdc)
Blank mode current	_____	(≤80mA)
Idle mode current	_____	(≤800mA)
Pump current	_____	(≤600mA)
SpO_2 current (if available)	☐ Nonin _____ ☐ Nellcor _____	(Nonin:≤80mA; Nellcor:≤120mA)
Temperature current (if available)	_____	(≤15mA)
Noise level	_____	(≤0.05mmHg)
Button test	_____	(Pass/Fail)
Print quality (if available)	_____	(Pass/Fail)
Unit leak @ 250 mmHg(245/255 mmHg)	_____	(≤5mmHg)
Unit leak @ 50 mmHg (45/55 mmHg)	_____	(≤5mmHg)
Inflation Time	_____	(≤7 seconds)
Dump time	_____	(≤10 seconds)
Deflation Test	_____	(Pass/Fail)
Over pressure value	_____	(296 to 329mmHg)
Over 15mm Hg	_____	(Pass/Fail)
Under 15mm Hg	_____	(Pass/Fail)
SpO_2 sim. reading (if available)		(Nonin:98%,80BPM; Nellcor:81%,112BPM)
SpO_2 sensor reading (if available)		(Pass/Fail)
Temp. “Cal-key” read (if available)	_____	(97.3±0.2˚F, 36.3±0.1˚C)
Temp. calibrator read (if available)	_____	(96.1˚F to 96.7˚F) (35.6˚C to 36.0˚C)
Temp. calibrator read (if available)	_____	(105.7˚F to 106.3˚F) (40.9˚C to 41.3˚C)

For test data specifications consult the Repair Test Specification Document.